

Claims

What is claimed is:

1. A process for sintering aluminum powder comprising the steps of:

a) providing an aluminum powder; and

5 b) heating said aluminum powder, in an atmosphere consisting primarily of nitrogen, at a predetermined temperature and a predetermined time to sinter said aluminum powder to a transverse rupture strength of at least about 13.8 MPa, wherein said atmosphere contains a partial pressure of water vapor in the range of about 0.001 kPa to about 0.02 kPa;

10 wherein said aluminum powder is not pressed together by a mechanical force that substantially deforms the particles of said aluminum powder prior to or during said step of heating.

2. The process of claim 1, wherein said aluminum powder has a composition
15 consisting essentially of aluminum.

3. The process of claim 1, wherein said aluminum powder is an aluminum alloy.

4. The process of claim 1, further comprising the step of mixing said aluminum
20 powder with ceramic powder.

5. The process of claim 4, wherein said ceramic powder includes at least one selected from the group consisting of alumina, silica, silicon carbide, boron nitride, and refractory carbides.

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6. The process of claim 1, further comprising the step of mixing said aluminum powder with a sintering aid.

7. The process of claim 6, wherein the composition of said sintering aid includes at least one selected from the group consisting of magnesium and tin.

8. The process of claim 1, further comprising the step of forming said aluminum powder into a shape prior to said step of heating.

9. The process of claim 8, wherein said step of forming includes containerization of said aluminum powder.

10. The process of claim 8, wherein said step of forming includes metal injection molding of said aluminum powder.

11. The process of claim 8, wherein said step of forming includes forming said aluminum powder by a layered manufacturing technique.

12. The process of claim 11, wherein the layered manufacturing technique includes the three-dimensional printing (3DP) process.

13. The process of claim 11, wherein the layered manufacturing technique includes the selective laser sintering (SLS) process.

14. The process of claim 1, wherein said partial pressure of the water vapor is in the range of about 0.003 kPa to about 0.015 kPa.

15. The process of claim 1, wherein said aluminum powder consists of particles in the size range of between about 1 micron to about 500 microns.

16. The process of claim 15, wherein the size range of said aluminum powder particles is between about 45 microns and 106 microns.

10 17. The process of claim 1, wherein in the step of heating, said aluminum powder is sintered to a relative density of at least about 60%.

18. The process of claim 1, wherein in the step of heating, said aluminum powder is sintered to a relative density of at least about 75%.

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19. The process of claim 1, wherein in the step of heating, said aluminum powder is sintered to a relative density of at least about 85%.

20 20. The process of claim 1, wherein in the step of heating, said aluminum powder is sintered to a relative density of at least about 95%.

21. An article comprising sintered aluminum powder, said sintered aluminum powder having a transverse rupture strength of at least about 13.8 MPa and a microstructure which contains no compositional concentration gradients indicative of the use of a

sintering aid and no evidence of particle deformation having occurred by an application of a mechanical force prior to or during sintering.

22. The article of claim 21, wherein said aluminum powder has a composition
5 consisting essentially of aluminum.

23. The article of claim 21, wherein said aluminum powder is an aluminum alloy.

24. The article of claim 21, wherein said article further comprises a ceramic.

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25. The article of claim 24, wherein said ceramic includes at least one selected from the group consisting of alumina, silica, silicon carbide, boron nitride, and refractory carbides.

15 26. The article of claim 21, wherein said article has a relative density of at least about 60%.

27. The article of claim 21, wherein said article has a relative density of at least about 75%.

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28. The article of claim 21, wherein said article has a relative density of at least about 85%.

29. The article of claim 21, wherein said article has a relative density of at least about
25 95%.